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# COTTON-SEED MIXING INCREASED BY MODERN GIN EQUIPMENT

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## INTRODUCTION.

It is generally known that the seed is mixed when one variety of cotton follows another at the public gin, but the extent of the mixture was not appreciated until a method of testing was developed and a careful experiment made at Greenville, Tex., in 1914. The results of that test showed that cotton seed was mixed at the public gins far more than was generally realized and emphasized the necessity for cooperation between the farmers and ginnermen if supplies of pure seed for planting were to be maintained.<sup>1</sup>

But the test of 1914 does not show the full extent of mixing, which has increased notably in recent years with the wider use of modern ginning equipment. The general tendency in the construction of gin plants has been toward more and larger gin stands, in order to make more efficient use of the power and other equipment and to speed up the handling of the seed cotton. These are desirable aims, but the change results incidentally in a further increase in the mixing of seed, which is already a serious menace to the preservation of superior varieties of cotton. Since each gin machine, or "stand," has a roll box in front of its saws, the large ginning establishments increase the extent of the mixing in proportion to the number of gin stands.

This circular is supplemental to that published in 1914 and shows the result of a similar test conducted in 1920 by one of the writers, Mr. Ballard, at Greenville, Tex., by the method that was used in 1914, but with a more recent type of ginning equipment.

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<sup>1</sup> Saunders, D. A., and Cardon, P. V. Custom ginning as a factor in cotton-seed deterioration. U. S. Dept. Agr. Bul. 288, 8 p., 5 fig. 1915.

## CAUSES OF COTTON-SEED DETERIORATION.

The maintenance of uniformity in length and quality of fiber is one of the most serious problems confronting the grower of cotton in the United States. As conditions now exist in many sections of the cotton belt, a farmer attempting to produce a superior staple is unable to maintain the high quality of his stock more than two or three years. He realizes that rapid deterioration in the quality of his cotton is taking place, but has always been led to believe that this was natural and inevitable with cotton, that varieties are bound to "run out," and that the only remedy is to get a new stock of seed every three or four years. That this "running out" in the quality of his cotton might be prevented by certain changes in the methods of growing and handling the crop by himself and neighbors has failed to receive the farmer's serious attention, in spite of numerous publications by State agricultural authorities and the United States Department of Agriculture.<sup>2</sup>

The most frequent and serious cause of deterioration in the uniformity and high quality of superior varieties of cotton is the general custom of growing a number of different varieties in the same locality and ginning the crops at centrally located public gins. When more than one variety is grown in adjacent fields they become cross-pollinated by the numerous flying insects that visit the flowers. Pollen from different varieties is interchanged, and in a few seasons the stocks are so badly mongrelized that they no longer represent the varieties originally planted.

Not only is such crossing of varieties in neighboring fields taking place, but also the crossing of different kinds takes place in the same field as a result of the planting of seed mixed at public gins. After the crops are harvested the seed cotton of each farming community is hauled to one or more public gins. Just how much mixing of seed takes place at the gin is not easily determined. Little has been published on the extent of this mixing at the gin, and consequently the seriousness of the evil has not been appreciated. The fact that the seed of practically all of the commonly grown short-staple varieties is similar in appearance is largely responsible for the difficulty in determining the extent of the mixing. To overcome this difficulty and to measure its extent with reasonable accuracy, a method was worked out by Mr. D. A. Saunders, at Greenville, Tex., in 1914 by artificially coloring the roll of seed in the roll box, so that the seed could easily be distinguished.

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<sup>2</sup> Cook, O. F. Cotton selection on the farm by the characters of the stalks, leaves, and bolls. U. S. Dept. Agr., Bur. Plant Indus. Circ. 66, 23 p. 1910.

— Cotton improvement on a community basis. *In* U. S. Dept. Agr. Yearbook, 1911, p. 397-410. 1912.

**HOW THE SEED IS MIXED IN THE ROLL BOX.**

The process of ginning is familiar to most farmers in the cotton belt, but the following points may be stated for those who are not in touch with cotton and do not understand the important part that the ginning operation plays in the general scheme of production and the price the farmer receives for his product.

In the usual ginning process the seed cotton is taken from the farmer's wagon by a pneumatic-elevator system and conveyed through the chutes to the gins. After undergoing a certain amount of mechanical shaking, beating, and blowing to clean out the trash, the mass of seed cotton is in condition for the actual ginning operation and is dropped from a chute into a so-called "feed box" at the top of the gin and then down to the roll box, where the separation of the lint from the seed takes place.

Upon entering the roll box the seed cotton falls upon the "ribs" of the "gin breast." Here, the rapidly revolving circular saws, one of which protrudes between each pair of ribs, catch the lint, pull it from the seed, and carry it around to the brushes, which take the lint away from the saws and pass it into the lint flues, through which it is carried to the press. The seed, being too large to pass between the ribs and the saws, falls from the saws and slides into a trough and is carried by means of a revolving screw conveyor either to hoppers that dump it into the farmer's wagon or to the seed house, for shipment to the oil mills.

The rapidly revolving saws, passing through the mass of seed cotton in the roll box, give it a rotary motion, and the revolving mass, becoming somewhat compact, assumes the shape of a roll, which gives rise to the name roll box.

Gradually, most of the lint is removed and the mass becomes more truly a roll of seed. The seed cotton falling upon this roll is fed to the saws and the lint carried away, the seed remaining as part of the roll or falling into the conveyor. In this way there is a constant exchange in the seed in the roll.

After the seed roll has been formed at the first operation of the gin, it is often allowed to remain in place through the whole ginning season. The ginners try to avoid having the roll run out, on account of its function of giving the seed cotton better contact with the saws. The mechanical function of the roll needs to be recognized in order to appreciate the real difficulty with the present type of machinery and equipment, which amounts almost to a practical impossibility, of keeping different kinds of cotton separate at the gins. Indeed, some ginners follow the practice of stopping the gin just before the last seed cotton of each lot passes out of the feeders, so that an additional quantity remains to be ginned with the first bale of the next



farmer. It is the general custom, however, for the ginner to run the gins a few minutes after the last of the farmer's cotton leaves his wagon, in order to empty the feed boxes and free the seed roll of most of the lint, but leaving a roll of 1 or 2 bushels of ginned seed in each of the gin stands.

Thus, from the nature of the gin machinery, if different varieties of cotton are grown in the same locality and ginned on the same gin the mixing of the seed stocks must occur. Though some mixing occurs in the flues and feeders, where small numbers of seeds are likely to be caught on joints or on the rough surfaces, extensive mixing occurs in the roll box with its mass of seed that is regularly carried over from one operation to the next.

#### DEMONSTRATING THE MIXTURE OF SEED.

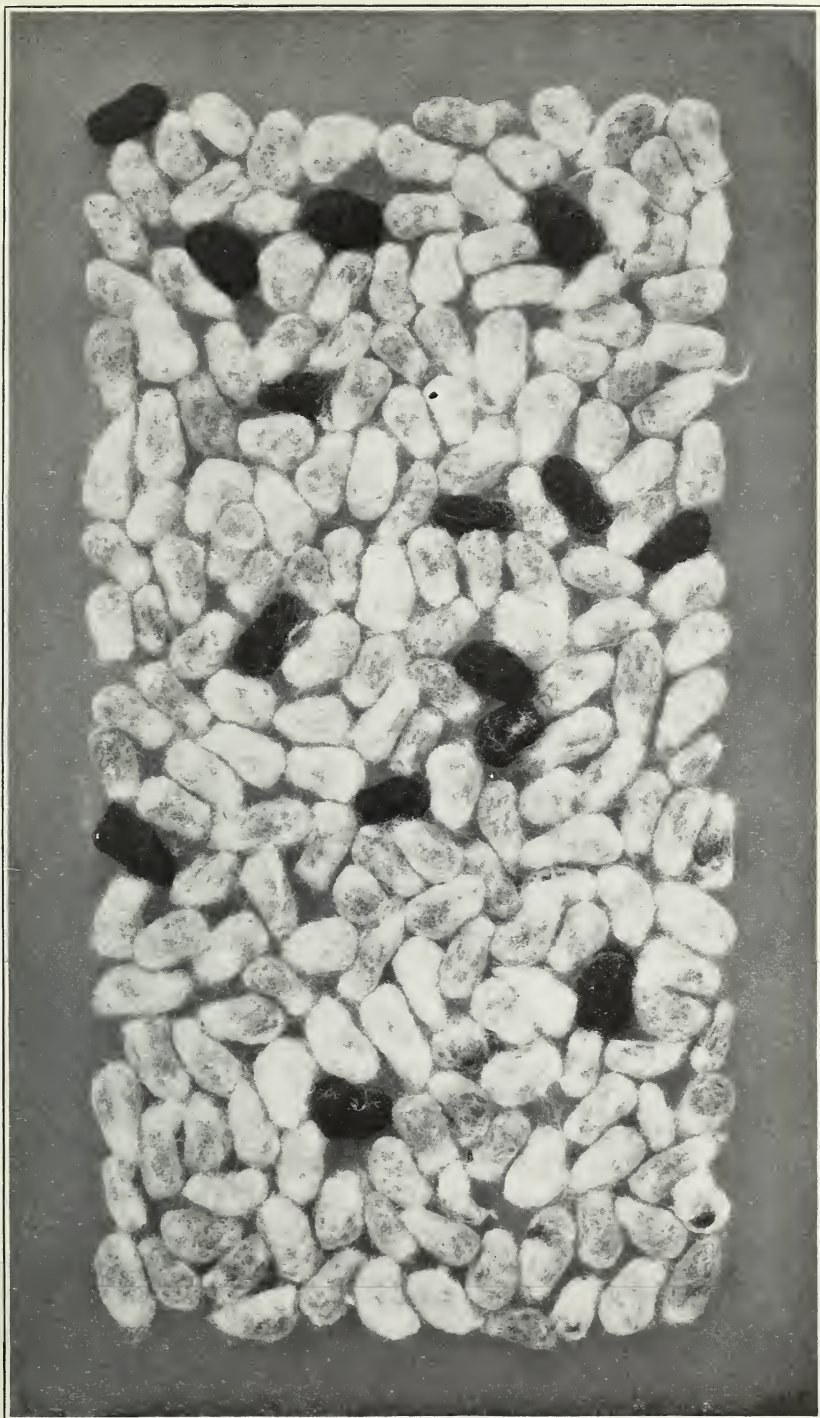
After the ginning of cotton of the variety produced by one farmer has been completed, the seeds that remain in the roll box are gradually replaced by seeds from the next farmer's crop as it passes through the gin. The case would be different if the seeds that remain over in the roll all came out at once, as soon as the gin started. The actual result is that the seeds remaining from the first lot mix gradually with the seeds of the second lot; the two kinds fall together into the conveyor and are carried to the farmer's wagon to be used as planting stock the next season.

In order to determine the rapidity of exchange that takes place in the roll box, the method outlined below was employed by Mr. Saunders in 1914.

The seed roll was removed from a 70-saw gin and the seeds were stained with ordinary aniline dye in order to give the fuzz a red color, making them very conspicuous among the white or grayish natural-colored seeds. (Pl. I.) After being dyed the seeds were thoroughly sun dried and then returned to the roll box, the roll being packed as nearly as possible to the same density it was before being removed. When the next bale was ginned, samples of the seeds were taken every 5 minutes as they dropped from the roll box into the conveyor. The proportion of red seeds in each sample was then determined, with the results shown in Table I, which with the accompanying statement is taken from Department Bulletin No. 288.

For several minutes only stained seed appeared. After the gin had been running 5 minutes the sample taken showed 52 per cent of colored seed. At the end of the first 10 minutes the sample showed 17.1 per cent of stained seed, and after 15 minutes 7.4 per cent, while at the end of 20 minutes 2.8 per cent of stained seed appeared in the sample. The sample taken at the end of 25 minutes showed 0.5 per cent of stained seed, and the one taken at the 30-minute period showed 0.1 per cent, or 1 seed in a sample of 801 seeds.





SAMPLE OF COTTON SEED TAKEN 15 MINUTES AFTER GINNING BEGAN, STILL SHOWING 7.4 PER CENT OF DYED SEED FROM THE SEED ROLL LEFT OVER FROM PRECEDING BALES. FROM SAUNDERS'S EXPERIMENT IN 1914.

Natural size.



TABLE I.—*Extent of mixture in samples of cotton seed taken from the roll of a single gin stand in a battery of three stands at intervals of five minutes, as determined at Greenville, Tex., September 7, 1914.*

Time of sampling after ginning had begun.	Number and character of seeds in each sample.			Red seed.
	Total.	White.	Red.	
5 minutes.....	521	250	271	<i>Per cent.</i> 52.0
10 minutes.....	478	396	82	17.1
15 minutes.....	527	488	39	7.4
20 minutes.....	835	812	23	2.8
25 minutes.....	603	600	3	.5
30 minutes.....	801	800	1	.1

When the bale was ginned, the roll was carefully examined, and 32 stained seeds were found. Not until 10 minutes after the second bale had been started did these pass out of the gin. No stained seeds were found in the roll box after the ginning of the second bale.

#### EXTENT OF MIXTURE WITH MODERN GINNING EQUIPMENT.

The results mentioned above were obtained from a single gin stand in a battery of three stands and indicate an admixture of 14 to 16 per cent in the seed from the first bale received by the farmer when his predecessor at the gin had a different variety.

In order to determine approximately the increase in the amount of mixture that takes place in the larger and more modern ginning equipments, a similar test was conducted in 1920, with the results stated below.

The gin used in this test was a 5-stand battery of 80-saw gin units. With this equipment it is possible to gin an average 500-pound bale in from 11 to 18 minutes, depending upon the condition of the seed cotton and the consequent speed that can be used with safety.

The seed roll was dropped from one stand, the seed stained with aniline dye, dried, and replaced in the roll box before the day's run was commenced. The first stand was selected, for the reason that seed cotton reaches this stand first and consequently more cotton is ginned from it than from any one of the other four units. The weight of the seed in the roll was approximately 60 pounds (59.6 pounds).

As soon as the stained seed had been replaced in the roll box the gin was started and samples were taken from under the stand at intervals of about 1 minute throughout the entire time of ginning. The bale was finished in slightly more than 13 minutes. The number and percentage of stained seed in the samples were as shown in Table II.

From these data it is seen that about 50 per cent of the old roll passed out of the stand within 3 minutes after the new bale was started, and about 75 per cent within 4 minutes. After that, the

reduction of stained seed was slower and steadily decreased, but when the ginning of the bale was finished nearly 3 per cent of the colored seeds were still in the gin. Even a more gradual mixture of the old seed with the new is to be expected in actual practice, in view of the probability that the roll of stained seed was not as compact and coherent after it was replaced in the roll box as would ordinarily be the case with a naturally formed roll.

TABLE II.—*Results of sampling cotton seed at 1-minute intervals for 13 minutes during the process of ginning the first bale.*

From start to time of sampling.	Total number of seeds counted.	Stained seed.	
		Total.	Per cent.
1 minute.....	300	299	99.7
2 minutes.....	400	357	88.6
3 minutes.....	400	206	51.2
4 minutes.....	400	108	27.0
5 minutes.....	400	82	20.5
6 minutes.....	400	72	18.0
7 minutes.....	400	49	12.2
8 minutes.....	400	26	6.5
9 minutes.....	400	22	5.2
10 minutes.....	400	22	5.2
11 minutes.....	400	20	5.0
12 minutes.....	400	11	2.7
13 minutes.....	400	11	2.7

The gin was stopped when the ginning of the first bale was finished, to allow samples to be taken directly from the roll. The percentage of stained seed remaining in the roll was as shown in Table III.

TABLE III.—*Stained cotton seed remaining in the roll after ginning one bale.*

Portion of the roll examined.	Total number of seeds counted.	Stained seed.	
		Total.	Per cent.
Surface.....	800	13	1.6
Center.....	1,400	36	2.55

The higher percentage of stained seed found in the center of the roll is to be expected, as naturally the change of seed is less rapid in that portion of the roll not exposed to the saws and moving in a smaller circumference.

Samples taken at 2-minute intervals during the ginning of the second bale showed a decrease of stained seed from 2 per cent in the first sample to nothing in the last, as shown in Table IV.

Samples taken from the roll after completing the ginning of the second bale still showed a trace of stained seed that had remained through the ginning of both bales. One stained seed was found in



1,500 taken from different parts of the roll, but even this small proportion would serve to contaminate a seed stock in a few seasons.

TABLE IV.—*Results of sampling cotton seed at 2-minute intervals for 10 minutes during the process of ginning the second bale.*

From start to time of sampling.	Total number of seeds counted.	Stained seed.	
		Total.	Per cent.
2 minutes.....	500	10	2.0
4 minutes.....	500	5	1.0
6 minutes.....	500	2	.4
8 minutes.....	500	2	.4
10 minutes.....	500	0	0

Following this test, all seed delivered from the first stand during the ginning of an average bale was caught on the floor and weighed. This one stand was found to have ginned out 221 pounds of seed. Estimating the total seed from the lint required to make a 500-pound bale at 890 pounds it is seen that this stand ginned 24.8 per cent of the bale. From the counts of stained seed taken from the preceding bale it is found that approximately 97.3 per cent of the 60-pound roll would be included in this 221 pounds. The weight of stained seed dropped during the ginning of the first bale would therefore be about 58.4 pounds, or 26.2 per cent of the total production of the stand. In other words, 26.2 is the indicated percentage of admixture in the seed of the first bale that the farmer receives when his cotton follows a different variety at the gin.

For the second bale there would still remain 1.6 pounds of stained seed, corresponding to an admixture of about 8 pounds in the seed of the farmer's second bale, with a few seeds left for the third bale.

Since most farmers do not bring at one time to the gin seed cotton sufficient for more than one or two bales, they have no prospect of getting any unmixed seed unless precautions are taken to drop the roll and clean the gin machinery at the beginning of the operation.

#### MIXING SEED IN THE SCREW CONVEYOR.

By means of the stained-seed method it has been possible to show the approximate percentage of admixture of seed that takes place in the roll boxes with modern ginning equipment. These figures have been obtained by catching the seed at intervals as it fell from the roll box and before it reached the conveyor. Though the percentage of admixture found in the roll box was much greater than had been realized before for that part of the machinery, it by no means represents the full extent of the mixing that takes place in the ordinary course of ginning when no precautions are used. The screw conveyor that takes the seed away from the gin is responsible

for the mixing of seed stocks to a far greater extent than any other part of the ginning equipment.

The seed conveyor is a long trough, or channel, containing a large revolving screw that pushes the seed along until it reaches the farmer's box or the seed house. Since it is practically impossible to clean a conveyor satisfactorily, the need of catching the seed under the gin has been recognized by those who take other precautions, as necessary to prevent mixing. But farmers are sometimes assured by ginners that the conveyor cleans itself and that "there is no danger after the first bale has gone through." Most farmers actually receive their seed through the conveyor and not direct from the roll box. Accordingly, a test was made in order to obtain more information as to the part played by the conveyor in the general evil of mixing seed at public gins.

The seed remaining under the stand at the head of the conveyor was removed at the end of the day's run, weighed, stained, and replaced. The weight of seed remaining under this part of the screw was found to be 12 pounds, corresponding to about 70 pounds for the entire length of conveyor under the five stands and 8 feet additional, to the point of discharge. The conveyor used in the test pushed the seed out to a carrier, which then lifted the seed to another screw conveyor, and this in turn carried it 40 feet to the seed house or the farmer's box. Based on the quantity of seed lying in the lower trough it is safe to estimate that the upper conveyor contained about 60 pounds of seed. The total weight of seed in the two horizontal conveyors and the one lifting conveyor, therefore, could not be less than 140 pounds.

The quantity of stained seed used in the test was too small to give accurate percentages showing the rate of movement of seed through the conveyors, because the stained seeds did not come through together but were scattered through the whole length of the conveyor system and through the whole volume of seed. Some of the stained seed began to appear at the end of the lower conveyor within 2 minutes after the beginning of the ginning of the first bale and within 4 minutes at the farmer's box at the other end of the conveyor system. Small numbers of stained seed continued to appear in the farmer's box during the ginning of the fourth bale, and after this bale was finished a few stained seeds were still found scattered about in the lower conveyor. Thus it is plain that the exchange or gradual replacement of seed in the conveyor is slower and more gradual than in the roll box of the gin stand.

#### **SIGNIFICANCE OF THE RESULTS OBTAINED.**

That careful methods of seed selection must be supplemented by precautions in ginning if the quality of superior varieties of cotton



is to be maintained is amply shown by these results. It is obvious that farmers must use means to prevent the mixing that now takes place at public gins before they can maintain the purity of their seed stocks or earn the premiums that uniformity in quality and length of fiber will justify on the market.

By means of the stained-seed method it has been shown that modern ginning equipment as commonly operated may mix the seed to the extent of about 26 per cent in the bale after the ginning of one variety and that the seed of the second and even the third bale receives some admixture. It has also been shown, through the screw-conveyor test, that stained seed were present in the lower conveyor after the ginning of the fourth bale.

It is possible, but only with special care and extra labor, to avoid the mixture of seed in modern ginning establishments in communities that grow more than one variety of cotton. As the mixture takes place not only in the gin itself when the roll is not dropped, but also in the conveyors, both before and after the actual ginning takes place, dropping the "seed roll" and cleaning the gin stands do not prevent mixture if the seed is run into conveyors which are not cleaned and usually are so constructed that cleaning is practically impossible.

Though the extent of the mixture can be reduced by dropping the roll, this precaution amounts to little unless the seed is kept out of the conveyors. All seed for planting should be caught under the gin stands and sacked at once instead of being handled in bulk or allowed to go through the conveyors.

With a number of different varieties being grown in the same community and handled in succession at public gins, a farmer who buys and plants a stock of pure seed is likely to receive an admixture of seed of at least two other local stocks when he gins his cotton at the end of the first season. Even if his field is well isolated, so that the blooms are not cross-pollinated by bees, he still does not have pure seed to plant the following year. The mixing of seed at the gin provides for a great deal of crossing in the field during the next season. Thus, deterioration is well on its way, and when the second crop is brought to the gin two or three other varieties may be added to it, so that in a few seasons the superior stock becomes thoroughly mongrelized and no longer represents the variety originally planted.

#### **NEED OF COOPERATION IN ORDER TO MAINTAIN SUPERIOR VARIETIES.**

In view of the difficulties in avoiding the mixing of seed at gins, the most practical way of maintaining pure seed supplies is for farmers to unite upon a single variety so that only one kind of seed will be

handled at the gin. In this way the mixing of seed at public gins may be eliminated entirely and the quality of cotton varieties kept up for long periods of time. Pure uniform stocks of seed can be maintained only in one-variety communities, limiting the planting to a single variety. In this way all the cotton going to the gin from that locality is of one variety, and if the seed for planting purposes is carefully handled the quality of a selected cotton may be maintained for an indefinite time.<sup>3</sup>

In the event that difficulty arises among the farmers in agreeing upon the single variety of cotton to plant it is still possible for interested farmers and ginnermen to cooperate to the extent of taking the necessary precautions to prevent seed from becoming mixed at the gins. Though most ginnermen dislike to stop and clean out their gins during the busy season, since this involves a loss of time and money, still it is often possible to make some arrangement for handling planting seed. One day a week may be devoted to the ginning of selected stocks after cleaning out the flues, feeders, and cleaners, dropping the seed roll, and cleaning out the roll box. As it is not possible to clean the seed conveyor thoroughly, seed for planting purposes should not be permitted to pass through it. A slight adjustment of the apron of the gin will keep the seed from falling into the conveyor and bring it out upon the floor of the gin house, to be sacked immediately. The floor, of course, must be clean, to prevent possible mixture with stray seeds, or a canvas can be spread upon the floor to receive the seed.

Should the plan for special days for ginning the planting seed not appeal to ginnermen, arrangements might be made for storing and holding over the seed cotton from select stocks to be used for planting purposes until after the rush season, when precautions can be taken with no serious loss of time.

Undoubtedly the most effective method of avoiding seed mixture at the gins and the cross-fertilization of different varieties of cotton in the fields is through the organization of one-variety communities. The value of one-variety communities has already been demonstrated in the Salt River Valley of Arizona, where the Pima variety of Egyptian cotton is grown exclusively.

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<sup>3</sup> Cook, O. F. Cotton improvement on a community basis. *In* U. S. Dept. Agr. Yearbook, 1911, p. 397-410. 1912.

McLachlan, Argyle. Community production of Durango cotton in the Imperial Valley. U. S. Dept. Agr. Bul. 324, 16 p. 1915.

Scofield, C. S., et al. Production of American Egyptian cotton. U. S. Dept. Agr. Bul. 742, 30 p. 1919.



